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Can a single plume explain widespread volcanism in the North Atlantic / Greenland region around 60 Ma?

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Around 60 Ma, more or less simultaneous volcanism occurred in Baffin Island, Western and Eastern Greenland, the Faroes, the British Isles and offshore regions. After reconstructing Eurasia and Greenland (North America) back to their location around that time, by closing the Northeast Atlantic and the Labrdaor Sea, some of these locations are still ∼2000 km apart from each other. If this is due to a single plume, material would need to flow for more than 1500 km from a putative plume center to some of the locations where volcanism occurred. Here we combine new insights from seismology, plate reconstructions and geodynamic modelling, and discuss how they may help with explaining the distribution of volcanism (the North Atlantic Igneous Province) in space and time.

Plate reconstructions in a moving hotspot reference frame position the Iceland plume near the East Greenland margin around 60 Ma. The Northeast Atlantic started opening shortly after that time in that area. Where plume material flows from there, and where melting occurs, depends on variations in thickness of the lithosphere. Here we infer its present thickness from a new Arctic tomography model AMISvArc, and use a plate tectonic model to reconstruct its thickness in the past.

The reconstructed lithosphere is rather thin (less than 100 km) along the East Greenland margin where the Northeast Atlantic started opening, as well as in the regions between the Iceland plume and Faroe Islands, Scotland and Ireland. Therefore plume material can be expected to have flown towards these regions, leading to volcanism there. The new tomography model also features a region of reduced seismic velocities in a corridor across Greenland. In particular higher temperatures in the 80-150 km depth range are indicated, pointing towards significantly thinner lithosphere. Such a corridor could facilitate flow of plume material beneath Greenland and have led to volcanism to the west of it, where seafloor spreading had occurred and the lithosphere had been thinned prior to opening of the Northeast Atlantic. In particular, this might occur if large-scale mantle flow is in a north to a-north-westerly direction.